This week By 12/6

DRAFT – FOR EPA REVIEW ONLY

Comments sent on 12/14 also sent for "Calculator

TECHNICAL MEMO 8

PROCEDURE FOR COMBINING MASS FRACTION ESTIMATES OF LIBBY AMPHIBOLE FOR ~~THE~~ COARSE AND FINE FRACTIONS OF A SOIL SAMPLE

1.0 INTRODUCTION

As described in SOP ISSI-LIBBY-01, soil samples collected from the Libby Asbestos Site (Site) are prepared for analysis of asbestos by sieving through a 1/4 inch sieve to generate two separate size fractions: 1) Coarse (particles that are retained on the 1/4 inch sieve), and 2) Fine (particles that pass through the 1/4 inch sieve). Each of these two fractions are then analyzed for asbestos as follows:

- The Coarse fraction is analyzed using stereomicroscopy and polarized light microscopy (PLM) to identify coarse particles that are asbestos, and estimating the mass percent by weighing those asbestos particles gravimetrically (SOP SRC-LIBBY-02).

- The Fine fraction is ground to less than or equal to 250 μm particle size and is evaluated by PLM-VE (PLM Visual Area Estimation) to estimate the mass fraction for Libby Amphibole (LA) using site-specific reference materials as a frame of reference (SOP SRC-LIBBY-03).

While results from both fractions (Coarse, Fine) are used by risk managers and the field teams to make decisions about the need for ~~outdoor~~ soil cleanup ~~at different properties~~, in some cases (e.g., exposure assessment, risk assessment), it may also be useful to combine the results across the two size fractions so that any given sample of soil may be characterized by a single concentration value. This technical memo describes a procedure for combining the results for levels of LA in these two fractions to yield a single value for each soil sample.

Conceptually, this same procedure could be used to compute the combined value for other forms of amphibole and/or chrysotile asbestos in the coarse and fine fractions of site samples, although this would require development of site-specific reference materials for these forms of asbestos.

2.0 APPROACH WHEN BOTH VALUES ARE QUANTITATIVE

When a soil sample is separated into two size fractions (fine and coarse) and quantitative results (expressed as mass fraction) are available for both fractions, the results for each fraction are combined by computing a mass-weighted average mass fraction. In performing this computation, there are two alternative strategies that may be useful. These strategies differ from each other with respect to the treatment of the mass of the coarse fraction in the denominator of the calculation.

In the first approach, the mass of the coarse fraction is used in the denominator without adjustment, as follows:

$$MF_{LA}(total) = \frac{M(fine) \cdot MF_{LA}(fine) + M(coarse) \cdot MF_{LA}(coarse)}{M(fine) + M(coarse)}$$

where:

MF_{LA}(total)	=	Mass Fraction (%) of LA asbestos in the sample
MF_{LA}(fine)	=	Mass Fraction (%) of LA asbestos in the Fine fraction
MF_{LA}(coarse)	=	Mass Fraction (%) of LA asbestos in the Coarse fraction
M(fine)	=	Mass (grams) of the Fine fraction
M(coarse)	=	Mass (grams) of the Coarse fraction

This approach assumes that all of the material placed in the sample bag should be considered a valid part of the soil sample, regardless of particle size.

In the second approach, only the mass of LA in the coarse fraction is included in the denominator:

$$MF_{LA}(total) = \frac{M(fine) \cdot MF_{LA}(fine) + M(coarse) \cdot MF_{LA}(coarse)}{M(fine) + M(LA\ in\ coarse)}$$

where:

M(LA in coarse) = Mass (grams) of LA in the Coarse fraction

Note that:

M(LA in coarse) = M(course)·MF_{LA}(coarse)

This approach is based on the idea that particles larger than ¼ inch are not generally a valid component of the soil fraction. However, LA particles retained in the coarse fraction are included because they are more susceptible to being broken down into smaller particles by weathering or mechanical forces than other coarse soil particles.

The choice between these two strategies depends on the intended use of the data, and each data user should consider which approach yields the results that are most appropriate for their intended purpose. For example, the first approach may be appropriate for a soil sample from a residential yard in which there are no coarse rocks, while the second approach may be most appropriate for a sample from a gravel driveway ~~in may~~ of the pieces of gravel may be larger than ¼ inch. All data users should explain the basis for the strategy they select.

Example calculations for each approach are presented in Figure 1, below.

3.0 APPROACH WHEN EITHER RESULT IS SEMI-QUANTITATIVE

In the PLM-VE approach for evaluating the concentration of LA in the fine fraction, if the concentration of asbestos is judged to be less than 1% by mass, the reported result is semi-quantitative, using the following scheme:

PLM-VE Result	Bin	Description
ND	A	LA was not observed in the fine fraction
Tr	B1	LA was observed in the fine fraction at a level that appeared to be lower than the 0.2% LA reference material
< 1	B2	LA was observed in the fine fraction at a level that appeared to exceed the 0.2% reference material but was less than the 1% LA reference material

If the concentration is 1% or greater, the sample is characterized as "Bin C".

Likewise, in the gravimetric analysis of the coarse fraction, if there are no particles large enough to remove and weigh, the results are reported as one of two bins, as follows:

Gravimetric Result	Description
ND	LA was not observed in the coarse sample
TR	LA was observed in the coarse sample, but the amount was too small to quantify by weighing

In the event that either result (fine fraction and/or coarse fraction) is reported semi-quantitatively, then a semi-quantitative value to characterize the mass-weighted average concentration may be derived as follows:

1. For each semi-quantitative result, assign a surrogate quantitative value to represent the semi-quantitative value.
2. Combine the quantitative and surrogate values using one or both of the options described above for fully quantitative results.
3. Assign a semi-quantitative bin to the combined results.

Assignment of Surrogate Values

For semi-quantitative values assigned to the fine fraction following PLM-VE analysis surrogate point estimate values for the bins are as follows:

PLM-VE Bin	Nominal Range	Surrogate Point Estimate
A	< 0.05%	0.025%
B1	0.05% to 0.2%	0.125%
B2	0.2% to 1%	0.60%

The value of 0.05% for Bin A samples is based on the results of a pilot study in which a series of Bin A samples from Libby were examined by both transmission electron microscopy (TEM) and scanning electron microscopy (SEM) in order to estimate the mass fraction of LA that was present (EPA 2007). The bounds for Bins B1 and B2 are based on the nominal values of the site-specific reference materials used in the PLM-VE analysis.

For the gravimetric analysis of the coarse fraction, the assignment of surrogate values for the ND and TR bins is somewhat less certain. Based on ..., the following surrogates are used:

Coarse Fraction Bin	Nominal Range	Surrogate Point Estimate
ND	< 0.005%	0.0025%
TR	0.005% to 0.1%	0.028%

Two examples of this approach are shown in Figures 2 and 3, below.

4.0 SPREADSHEET CALCULATION TOOL

Attachment 1 provides an electronic spreadsheet tool for combining results for coarse and fine soil fractions, using the methods described above.

5.0 REFERENCES

USEPA. 2007. Summary Report For Data Collected Under The Supplemental Remedial Investigation Quality Assurance Project Plan (SQAPP) For Libby, Montana. U.S. Environmental Protection Agency, Region 8. October 23, 2007.

FIGURE 1
EXAMPLE CALCULATIONS WHEN BOTH FRACTIONS ARE QUANTITATIVE

Example Data

Soil Fraction	Soil Mass (g)	Mass Fraction of LA
Fine	487	3.6%
Coarse	43	0.8%

Option 1: All particles in the coarse fraction are considered part of the soil sample:

$MF_{LA}(total) = [487 \cdot 3.6\% + 43 \cdot 0.8\%] / [487 + 43] = 3.4\%$ = .3

Option 2: Only asbestos in the coarse fraction is considered to be part of the soil sample:

$MF_{LA}(total) = [487 \cdot 3.6\% + 43 \cdot 0.8\%] / [487 + 43 \cdot 0.8\%] = 3.7\%$

1) $\frac{1753.2 + 34.4}{530} = 1787.6$

1753.2
.0344
1.7876 g LA ÷ 530 s

2) $\frac{1753.2 + 34.4}{521.4} = 1787.4$

FIGURE 2
EXAMPLE CALCULATIONS WHEN ONE FRACTION IS SEMI-QUANTITATIVE

Example Data

Soil Fraction	Soil Mass (g)	Mass Fraction of LA
Fine	487	B1
Coarse	43	0.2%

Option 1: All particles in the coarse fraction are considered part of the soil sample:

Step 1: Assign surrogate values (shaded)

Soil Fraction	Soil Mass (g)	Mass Fraction of LA
Fine	487	0.125
Coarse	43	0.2%

Step 2: Compute surrogate mass-weighted average:

$MF_{LA}(total) = [487 \cdot 0.125\% + 43 \cdot 0.2\ \%] / [487 + 43] = 0.13\%$

Step 3: Translate surrogate mean to semi-quantitative bin:

0.13% = Bin B1

Option 2: Only asbestos in the coarse fraction is considered to be part of the soil sample:

Step 2: Compute surrogate mass-weighted average:

$MF_{LA}(total) = [487 \cdot 0.125\% + 43 \cdot 0.2\ \%] / [487 + 43 \cdot 0.2\%] = 0.14\%$

Step 3: Translate surrogate mean to semi-quantitative bin:

0.14% = Bin B1

FIGURE 3
EXAMPLE CALCULATIONS WHEN
BOTH FRACTIONS ARE QUAN~~T~~ITATIVE

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Example Data

Soil Fraction	Soil Mass (g)	Mass Fraction of LA
Fine	487	B2
Coarse	43	ND

<u>Option 1</u>: All particles in the coarse fraction are considered part of the soil sample:

Step 1: Assign surrogate values (shaded)

Soil Fraction	Soil Mass (g)	Mass Fraction of LA
Fine	487	0.60
Coarse	43	0.0025

Step 2: Compute surrogate mass-weighted average:

$$MF_{LA}(\text{total}) = [487 \cdot 0.60\% + 43 \cdot 0.0025\ \%] / [487 + 43] = 0.55\%$$

Step 3: Translate surrogate mean to semi-quantitative bin:

0.55% = Bin B2

<u>Option 2</u>: Only asbestos in the coarse fraction is considered to be part of the soil sample:

Step 2: Compute surrogate mass-weighted average:

$$MF_{LA}(\text{total}) = [487 \cdot 0.60\% + 43 \cdot 0.0025\ \%] / [487 + 43 \cdot 0.0025\%] = 0.60\%$$

Step 3: Translate surrogate mean to semi-quantitative bin:

0.60% = Bin B2

ATTACHMENT 1

Microsoft Excel Spreadsheet Tool for Computing Combined Results

See "Calculator v2.xls"